SKIN DISEASE PREDICTION BASED ON MEDICAL IMAGES USING DEEP LEARNING TECHNIQUES

SHORT SYNOPSIS

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Manav Rachna University

by

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DECLARATION BY THE SCHOLAR

I hereby declare that the short synopsis entitled **Skin disease prediction based on medical images using Deep Learning Techniques** being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in the Department of **Computer Science & Technology** under the **School of Engineering** of Manav Rachna University, Faridabad during the academic year **2025-2026.** It is the work that is expected to be carried out under the supervision of **Dr. Ranjna Jain** and Co supervision of **Dr. R. Girija.**

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ABSTRACT

These days, skin conditions are highly prevalent. If ignored, some of these conditions can lead to skin cancer. Deep learning has emerged as a more effective method for early disease prediction in recent years. Various advancements are made in the healthcare industry to detect various diseases. Deep learning methods are utilized for predicting diseases and general patient care. These approaches give improved results and reduce error rates. Using deep learning dermatoscopic images skin diseases can be detected at an early stage.

The proposed study will use image enhancement techniques to improve the quality of images and then apply segmentation techniques to segment the skin lesions. Feature extraction methods are used to extract important features and then using classification models different skin diseases can be identified. This framework will support clinical decision-making in dermatology.

Keywords: Dermoscopic images, Thresholding, Deep Neural Network, Grabcut segmentation, Feature extraction.

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1. INTRODUCTION

Now-a-days skin diseases are very common such as acne, rashes, rosacea etc. Some skin diseases can even lead to skin cancer. Skin diseases lead to various negative consequences such as depression, lack of confidence, embarrassment etc.

According to the survey statistics Acne is the highest occurring skin disease [1] in India approx. 73% of population is affected, then shingles with 20-30% [2], next is Hives with 15-20% [3] and so on. These conditions are often visible as redness on skin, rashes, lesions, blisters which vary in severity and appearance. If these diseases are not timely treated can have adverse health effects like acne can lead to permanent scars, Hives can lead to severe swelling affecting lips, eyes or throat. Shingles is contagious and, in some cases, can lead to vision or hearing loss. Dermatitis can lead to skin thickening [4]. Some of them have the same symptoms, so prediction of disease at the initial stage is very important for proper treatment.

Deep learning is evolving very fast and its application is spread in various areas. Deep learning models have enabled fast, accurate and more efficient operations in the healthcare sector. In the healthcare industry, it is used for detecting diseases. It has different methods which predict diseases faster and efficiently than humans such as CNN (Convolutional Neural Networks). Deep learning algorithms simplify complex data analysis, so defects can be identified and prioritized more precisely. It also delivers personalized patient care by analyzing the patient's medical history and symptoms. The methods for diagnosing diseases are changing over time with the evolution in new technologies. There are multiple deep learning techniques which prove great potential in finding symptoms for diseases. It increases the accuracy of diagnosis. It also reduces human involvement and error. There are vast areas of application of deep learning such as- Healthcare, fraud detection, semantic analysis etc.

Deep learning [5-7] has turned up as an efficient artificial intelligence technique that learns multiple layers of representations or features of the data and produces effective prediction outcomes. Deep learning algorithms are efficient in finding hidden patterns in data through self-learning processes. Deep learning algorithms learn by examples to train the machines.

Deep learning solves real world problems in different steps. First step to understand the data and pre- processing it. In the next step the model is built and trained. And then interpreting and validating the data. DL build up multi-layer learning models, these techniques have obtained eminent performance across extensive applications, including images, video and speech processing, natural language processing (NLP), comparative to other traditional models.

2. LITERATURE REVIEW

For the diagnosing various diseases different researchers have proposed different techniques those are discussed below-

Yuan[5] proposed a model to detect skin lesions- nevus, seborrhoeic keratosis and malignant melanoma. CDNN is used with 29 layers of network and Reluis used as activation function. The model used an online dataset. 750 images were used and accuracy achieved is 78 % using python implementation.

Patnaik et al[6] presented a model to identify dermatological skin abnormalities. Deep learning algorithms used in this model are-Inception_ v3, MobileNet, Resnet, xception for extracting feature and algorithm like Random Forest or Logistic Regression for testing and training. Accuracy achieved by this model is 88%. To train the system model, samples of data from the entire dataset are used.

Mendes[7] proposed a model to predict 12 skin lesions. ResNet-152 architecture with over 3,797 images for training purposes is used. Accuracy achieved 96% for Melanoma and 91% for BCC and total accuracy was 78%. This model has the drawback of low accuracy.

Anabik Pal et al [8] proposed a model to predict Melanoma disease using CNN model including combination of ResNet50, DenseNet121 and MobileNet. The dataset used here is ISIC 2018 containing 173 images. Accuracy obtained by this model is 77.5% which is higher in comparison to accuracy achieved by each model individually.

Daniel et al[9] used an online dataset of more than 4000 images of a proposed model with CNN architecture with Googlenet and Inception v3 for prediction of autoimmune blistering diseases with accuracy of 80%.

Banasode et al. [10] presented a system for the detection of melanoma skin cancer, wherein handcrafted feature extraction and a support vector machine are applied to dermoscopic images of skin lesions. The accuracy of the presented model was found to be approximately 90% in classifying melanoma and non-melanoma, thus indicating the efficiency of traditional ML models in dealing with small datasets.

Gouda et al[11] developed a model to detect skin lesions with CNN models (Resnet, Inception).

ISIC dataset is used and achieved an accuracy of 85%. ESRGAN is used in this model for preprocessing for microscopic-level gradients.

Gosh et al [12] developed a model skinNet16 for detecting skin cancer. Model is based on CNN adamax optimizer is used, PCA for feature selection with 99% of accuracy.

Balazs[14] proposed an ensemble-based CNN framework with 2750 images used and achieved the accuracy of 89%. It classifies skin diseases in three classes- benign skin tumor, cancerous melanoma cases and seborrheic keratosis.

Ali et al[15] presented a DL architecture to identify skin cancer. This model achieved an accuracy of 99.77%. HAM 10000 dataset is used with inceptionv3 and Resnet to make this model.

Srinivasu et al[16]developed a model for classifying skin disease using DNN with MobileNet V2 and LSTM. This model used a HAM 10000 dataset and achieved accuracy of 85%. This model has drawback of low accuracy due to a smaller number of significant parameters are used.

Rahman et al[17]created a model to identify acne and Rosacea using CNN model with sigmoid activation function, to evaluate loss Binary cross-entropy is used. The model gives the highest accuracy of 99% by using EfficientNet.

Yeong et al[18] designed a model WonDerM to detect 7 different types of skin lesions. The model achieved the highest accuracy of 89%. The programme initially pre-processed images of skin lesions, built neural network architecture that was fine-tuned with segmentation task data, and then utilized an ensemble method for disease categorization. The drawback of this model is that low level features are not considered.

Nils et al[19] proposed a model to classify the different skin diseases. The CNN model is used with EfficientNets which can deal with multiple image resolutions, different input cropping strategies and input resolutions are also used but 75% is achieved which is also its drawback.

Ameri[20] developed a model for detecting skin cancer. CNN model is used with alexnet. This model achieved the accuracy of 84 % which is low.

Dusa et al[21] presented a model to identify cancerous skin lesion Melanoma. In this model dermoscopic images are used as they can capture high resolution images. ISIC 2019 dataset is used here.CNN architectures used for training are -EfficientNets, SENet154 and ResNet. U-net Architecture is used for segmentation. The model obtained 88% accuracy.

Saket et al[22] proposed a DCNN based model to detect skin cancer. Pre-processing is done using Keras Image Data Generator built in function. To boost the performance of the model relu activation function is used and obtains 92% accuracy.

Rehan et al[23] develop a model to predict Melanoma using CNN architecture. Adam optimizer and binary cross entropy loss Function is used to achieve the accuracy of 97%.

Chiranjibi[24]et al proposed the model to detect monkeypox disease using a deep learning model with ensemble approach to achieve the accuracy of 87%. The dataset contains 161 images in which 43 Monkeypox, 47 Chickenpox,17 Measles, and 54 Normal image samples of individuals. It has a drawback that the Dataset is small and pre-trained DL models are used, which could be a problem if they are deployed in a memory constrained setting.

Zhangli[25]proposed a model fixcaps to diagnose skin cancer. A CBAM(convolutional block attention module)is used to reduce the loss of spatial information by introducing it between the convolution layer and the capsule layer. The model obtained accuracy of 97%.

Pravin[26] et al proposed research to identify skin diseases using deep learning methods with MobileNetV2 to predict skin disease and LSTM to improve the performance. This model obtained the accuracy of 86%.

Hritam[27] proposed a model for identifying skin lesions based on CNN architecture. It has Boundary Attention, Reverse Attention and Parallel Partial Decoder modules. It uses Res2Net and combines two loss function Binary Cross-Entropy (BCE) loss and Weighted IoU loss functions.

Ramzi[28] proposed a model to identify 6 skin lesions, using DCNN and obtained 82% of accuracy. Low accuracy is its drawback.

Hafidz et al[29] suggested a model based on image classification to distinguish between Monkeypox and Measles disease. The dataset was taken from the kaggle platform which consists of 360 images containing normal, Monkeypox and measles disease. Pre-processing is done by using Tensorflow. CNN model is used with VGG-16 to achieve higher accuracy.VGG-16 takes long processing time but gives good performance. This model achieved accuracy of 83.333%.

Mingjun Wei et al[30] suggested a model to identify classification of skin diseases. In this paper they used CNN models (DenseNet201 and ConvNeXt_L) and attained accuracy of 92.12% and 92.88%. The prediction is performed using 2 dataset HAM10000 and a private dataset was collected by Medical College Hospital which contained 2600 images. The stochastic gradient descent (SGD) algorithm and MultiStepLR algorithm are used for optimization of model and to adjust the learning rate.

Vinay et al[31] presented a model using CNN architecture to classify between different skin diseases. The dataset contained 2000 images. The images are normalized and converted into grayscale images. ReLu activation function is used. The model achieved 98% of accuracy.

Ameera et al[32] presented a model to identify Monkeypox disease in which pretrained deep learning models are used and mobileNetV2 gives the highest accuracy of 99%. A total of 117 images are used as a dataset which is also its drawback. Deep Convolutional Generative Adversarial Network is used.

Rabbia et al[33] proposed a model to detect skin lesions. To remove noise GF filter is used, local binary patterns and Inception V3 are employed to extract features and for adjusting learning rates Adam optimizer is used. Skin cancer is divided into malignant and benign types using LSTM. The model obtained accuracy of 99%.

Malik et al. [39] presented a CNN-based CAD system for skin disease classification by utilizing the ISIC dataset for skin images. The authors achieved an accuracy of 87%.

Aquil et al. [40] have proposed a hybrid model that integrates traditional machine learning classifiers with a deep learning feature extractor for the early detection of various skin diseases for different skin tones. The model has utilized a deep CNN with traditional classifiers like SVM/RF for robust and generalized results. The proposed model has been evaluated for a multi-class clinical skin image dataset, and the results have shown good performance for the early detection of skin diseases. The proposed model has achieved a high accuracy of 97.5% for the detection of skin diseases.

Table 1: Comparison of different models

Year	**Ref.**	**Dataset Resources**	**Techniques**	**Disease**	**Accuracy**
2017	[5]	ISBI	Convolutional Deep Neural Network	Melanoma Detection	78%
2018	[6]	Own dataset	Inception_v3, MobileNet, Resnet, xception	Automated Skin Disease	88%
2018	[7]	MED-NODE, Edinburgh	CNN, ResNet-152,	Skin Lesions Classification	78%
2018	[4]	ISIC 2018	ResNet50 , DenseNet121 and MobileNet	Melanoma	73%

2018	[9]	private dataset	Ensemble CNN	Skin Diseases	89%
2019	[18]	HAM 10000	CNN with (DenseNet and U-net)	Classification of skin lesion	89%
2019	[19]	HAM 10000	CNN, Loss Balancing, EfficientNet	Skin Lesion Classification	74.2%
2020	[20]	HAM 10000	DCNN, Alexnet	Skin cancer detection	84%
2020	[21]	ISIC 2019	CNN, U net, with SOFTMAX	Classification of skin lesion	88%
2020	[15]	HAM 10000	inceptionv3 and Resnet	Skin cancer	99%
2020	[22]	HAM 10000	CNN with ResNeXt101	MCS cancer classification	92.83%
2021	[9]	Consolidated dataset from online repositories	CNN, GoogleNet, Inception v3	Autoimmune Blistering Diseases	80%
2021	[23]	HAM 10000	CNN with sigmoid function	Melanoma	97%
2021	[16]	HAM 10000	MobileNet V2 and LSTM.	Skin lesion	85%,
2021	[10]	Dermoscopic skin lesion images	Support Vector Machine	Melanoma vs non-Melanoma classification.	90%
2022	[12]	PH2and the ISIC datasets	Enhanced CNN	Skin Diseases	99%
2022	[17]	Acne grading classification dataset	Deep CNN's EfficientNet	Acne & Rosacea Detection	99%

2022	[11]	ISIC 2018	CNN ,models (Resnet, Inception)	Skin lesion	85%
2022	[26]	private dataset	MobileNetV2, LSTM	skin diseases	86%.
2022	[28]	Google images, Derma.Net, and ISIC 18	CNN	6 skin diseases (acne, athlete's foot, chickenpox, eczema, skin cancer, vitiligo)	82%
2022	[25]	HAM 10000	Convolutional block attention module	Skin cancer	96%
2022	[27]	HAM 10000	CNN with Res2Net	Segmentation of skin lesion	90%
2022	[33]	DermIS dataset	DL-Based Features Fusion and LST	Skin Lesion	99%
2023	[30]	HAM 10000 and private dataset	CNN models (DenseNet201 and ConvNeXt_L)	Skin Lesion Classification	93%
2023	[29]	Kaggle platform	VGG 16	Monkeypox and Measles Detection	84%
2023	[31]	private dataset	CNN	Skin Diseases	98%
2024	[39]	HAM10000 and ISIC	CNN	skin diseases	87%
2025	[40]	HAM10000	Densenet 121	skin diseases	98%

The comparison displayed as above in Table 1 shows different deep learning techniques which are being used in the healthcare sector for predicting various diseases. This literature review has highlighted the existing works on deep learning techniques used by different researchers for the detection of different diseases. In all these methods dataset is used from researchers, UCI (University of California, Irvine Machine Learning Repository), HAM10000 **(**Human against Machine with 10,000 Training Images**.),** ISIC **(**International Skin Imaging Collaboration) etc.

3. Deep Learning

Artificial Intelligence is a vast area which creates machines that mimic human intelligence to reason and act. Machine learning is a sub part of AI that utilizes algorithms with data to train the system and make predictions. Deep learning is an advanced form of ML that uses a multi-layer neural network to analyze complex data. The relationship among these domains is illustrated in Fig. 1. It is evolving very fast and its application is spread in various areas. For predicting various diseases different deep learning techniques are used.

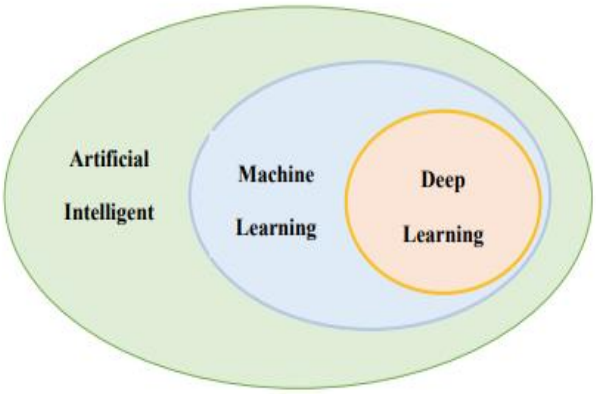


Fig. 1: Relationship between Artificial Intelligence, Machine Learning, and Deep Learning (Adapted from shiri et al [41])

3.1 DEEP LEARNING TECHNIQUES

There are various techniques/ algorithm are present some are discussed below-

1. CNN(Convolutional neural network)

It is a type of ANN. Earlier it was named LeNet and was developed by Yann LeCunin1988. It contains multiple layers to extract features and process data. It is used for image, object and speech recognition and also used in disease detection in healthcare. The architecture of CNN as shown in Fig. 2 is designed to act like the connectivity pattern of neurons within the human brain.

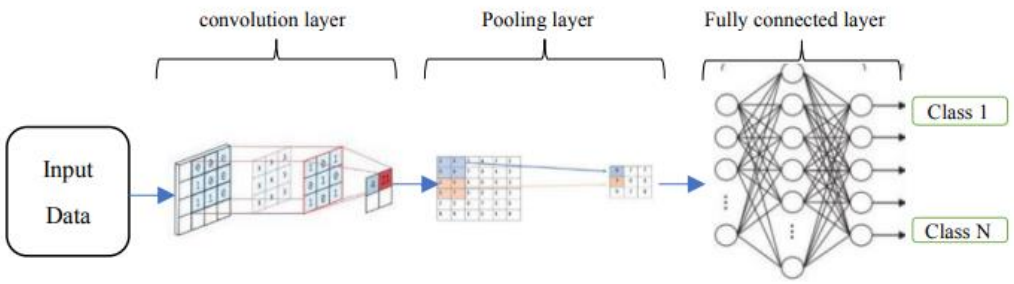


Fig 2: CNN architecture (Adapted from shiri et al [41])

2. RNN

Recurrent neural networks as shown in Fig. 3 give better analysis of temporal, sequential data or time series data such as videos. It contains different layers. It accepts output from one layer and gives it as input to the next layer. It is commonly used for NLP and speech recognition. They give good results in the areas in which prediction of context results is critical and are distinct from others. To process a sequence of data they use feedback loops to produce the final result, which can also be a sequence of data.

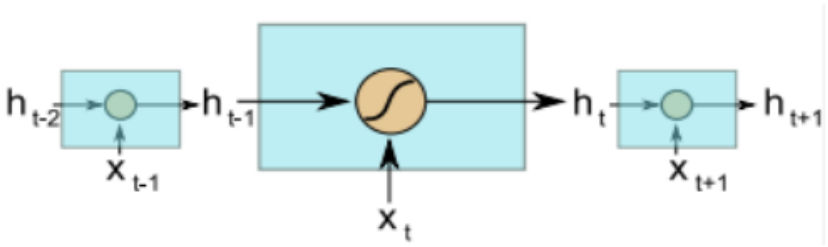


Fig. 3: RNN operation (Adapted from shiri et al [41])

3. LSTM(Long Short-Term Memory)

It is a subtype of RNN(recurrent neural network). It was originated by Hochreiter & Schmidhuber. RNN has a shortfall that it can give more accurate predictions from the recent information but is not able to detect the data stored for a longer period of time in memory.

LSTM as shown in Fig. 4 overcomes this shortfall by retaining the information for a longer period of time. It has a chain-like sequence structure that contains four neural networks and cells which are different memory blocks. Information is retained in cells and gates do the memory manipulation. There are three gates-forget gate which eliminates the data which is

not required by cell state, input gate which provides the needful data to the cell state and output gate which is responsible for extracting the result or output from the current cell state. Its application areas are image captioning, question answering chatbots, machine translation etc.

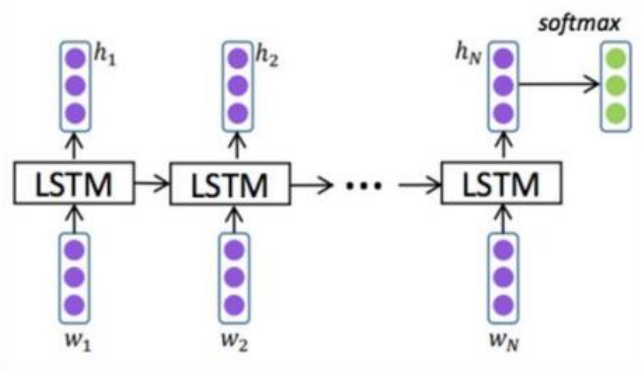


Fig. 4: High level architecture of LSTM (Adapted from shiri et al [41])

4. Autoencoders

These are types of neural networks which are trained to produce output the same as input. Autoencoders consist of the parts- encoder which displays encoded representation of data, bottleneck contains knowledge representation in a compressed form, decoder which decompresses the knowledge representation to the encoded form and then output is compared. The structure of Autoencoders is shown in Fig. 5. The most common use cases of encoders are- to perform efficient and highly accurate image denoising, denoising autoencoders are used for anomaly detection.

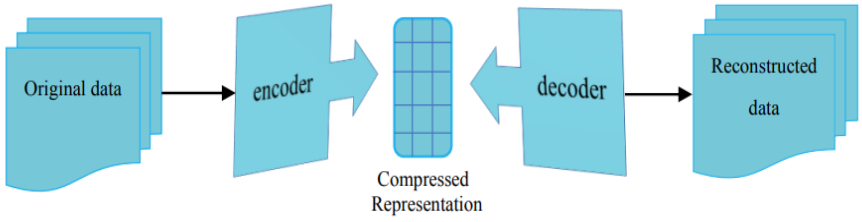


Fig. 5: Structure of Autoencoders (Adapted from shiri et al [41])

There are five popular autoencoders:

Under complete autoencoders- These are unsupervised and take images as input and reconstruct the image from the compressed bottleneck region and try to predict the same

image as output.

 Sparse autoencoders-

These are same as under complete but the only difference is sparse autoencoders are regulated by changing the number of nodes at each hidden layer.

 Contractive autoencoders-

It helps a neural network to encipher unlabelled data for training. By adding a regularizer, the algorithm minimizes the encoding which is less prone to small differences in its training dataset.

 Denoising autoencoders-

It removes noise from images. It is used to perform efficient and highly accurate image denoising, denoising auto encoders are used for anomaly detection; it can be used for reducing the dimensionality in a pre-processing step.

 Variation Autoencoders (for generative modelling)-

To avoid overfitting conditions and to make sure the latent space has good properties that enable generative process these encoders are useful.

5. Generative Adversarial Networks (GAN)

It was presented by Ian J. Goodfellow in the year 2014. It is used for un-supervised learning. It involves automatically learning the patterns from input data. This model produces new examples that could have been picked from the original data. The Generator generates false samples that can be any multimedia and tries to deceive the Discriminator. The Discriminator tries to discriminate between these real and false samples .The Generator and the Discriminator both run parallel to each other several times to get better in the training phase. The architecture of GAN is depicted in Fig. 6.

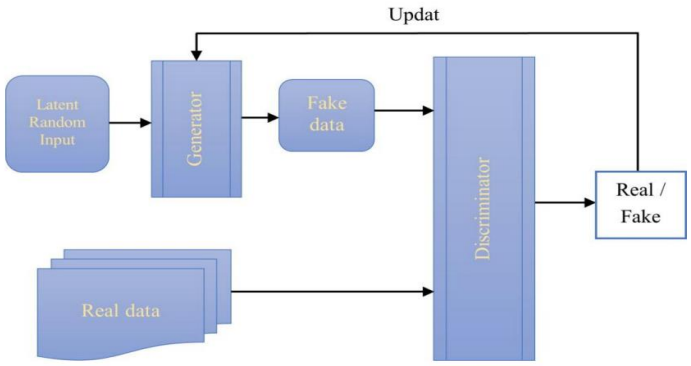


Fig. 6: GAN Framework (Adapted from shiri et al [41])

6. Deep Belief Network

It is a generative graphical model. It is made up of various layers of latent variables. It does not have connections between units within each layer in the connected layers. It was presented by Geoffrey Hinton in the year 2006. There are two steps to train a DBN, layer-by-layer training and fine-tuning. In fine tuning, an error back-propagation algorithm is used to fine tune the variables. In layer-by-layer training unsupervised training is given to each RBM. The structure of the DBN Model is depicted in Fig. 7.

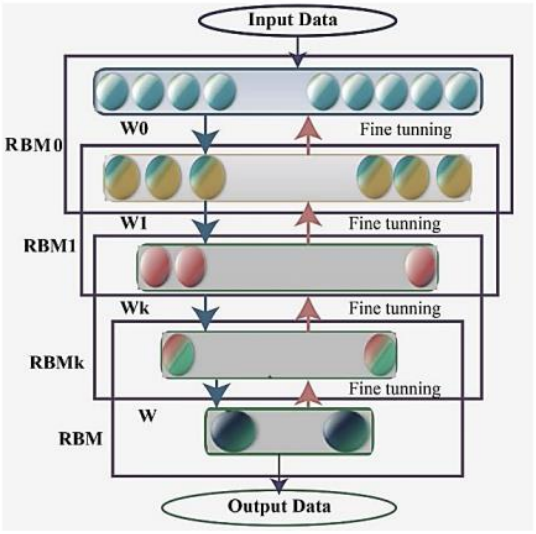


Fig. 7: Structure of a DBN model (Adapted from shiri et al [41])

7. VGG

VGG is a classical CNN architecture. It stands forVisual Geometry Group. It has two versions VGG-16 and VGG19 based on the number of convolutional layers present in the models 16 or 19. VGG has a vast variety of application areas like image classification etc. This model is introduced by the Visual Geometry Group from the University of Oxford, stood out in the 2014 ImageNet Large Scale Visual Recognition Challenge (ILSVRC). The architecture of VGG is depicted in Fig. 8.

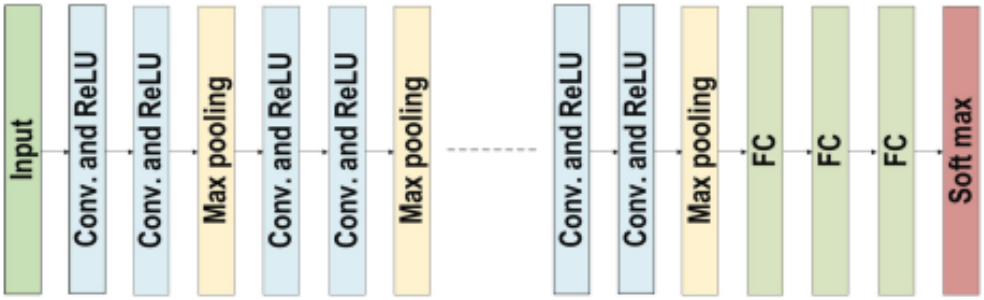


Fig 8: Architecture of VGG (Adapted from Ayad et al [42])

8. DenseNet

Densely Connected Convolutional Networks is a CNN architecture that connects all layers in a feed-forward fashion. It is developed to improve accuracy caused by the vanishing gradient in high-level neural networks. The architecture of DenseNet is shown in Fig.9.

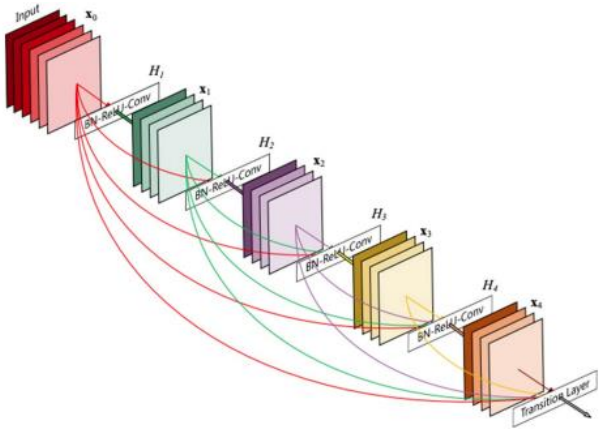
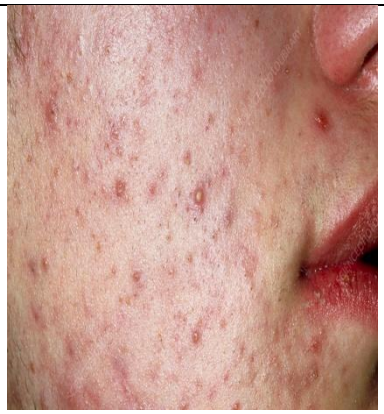


Fig. 9: The architecture of DenseNet Network (Adapted from Ayad et al [42])

3.2 Skin Disease

Skin diseases are very common these days. Skin related diseases can be caused because of numerous reasons like lifestyle, age and sex. The classification of skin diseases can be done using different methods but deep learning techniques are being used for getting more accurate and fast diagnoses of disease. Some of the common skin diseases occurring in India are discussed in Table 2.

Table 2: Comparison of different diseases

Sr. No.	Disease name	Description	Image
1	**Acne vulgaris**	It is a frequent type of acne that leaves marks on the face, little pustules, and small lumps and is described by a blended ejection of fiery and non-incendiary skin injuries. An underlying disease that necessitates medical attention may be the cause of an abrupt onset of severe acne.	
2	**Atopic dermatitis**	It is a chronic skin lesion causing stinging and disturbance, harsh, touchiness skin that is hereditary, with a red rash and dry, toughness.AD is not currently managed in any way. Treatment may include avoiding triggers, making lifestyle changes, and using medication to manage symptoms.	
3	**Scabies**	It is a contagious skin infection caused by the Sarcoptes scabiei mite, which results in itching and a rash due to the burrowing of the mite under the skin. This infection can be spread through physical contact.	

4	**Hives**	It is also known as urticaria, are raised, itchy patches on the skin that occur as a result of an allergic reaction or other factors such as food, medications, infections, or stress. They appear suddenly and disappear in a matter of hours or days, but in some cases, they can persist for a longer period of time.	
5	**Impetigo**	It is a highly contagious bacterial infection of the skin, most often caused by Staphylococcus aureus which is common in children. It presents as red lesions that rupture, drain, and develop a honey-colored crust.	
6	**Shingles**	It is a painful skin rash resulting from the reactivation of the varicella-zoster virus, the same virus that causes chickenpox. It usually presents as a band of rash with fluid-filled blisters on one side of the body or face.	
7	**Melanoma**	It can lead to cancer if not detected at an early stage. It has melanocytes cells when it grows out of control, creating a cancerous tumor. By reducing your exposure to UV radiation, you can lessen your risk of getting melanoma.	

8	**Psoriasis**	It is a chronic autoimmune disease that affects the skin, causing it to grow too quickly, resulting in thick, red patches of skin covered in silvery scales. The areas that psoriasis tends to affect are the scalp, elbows, knees, and lower back. It can be caused by stress, infections, or the environment.	
9	**Measles**	It is a dangerous, highly contagious, and airborne virus-based illness that can have fatal complications and cause skin rashes. It is a virus-based illness spread through the air. The rash at first shows up as level red spots on the face prior to spreading across the body.	
10	**Rosacea**	It is a chronic inflammatory skin condition that can cause flushing, blushing, and skin irritation. Rosacea is a chronic skin disorder that primarily impacts the face.	

4. Research Gaps

1. Researchers are using image datasets for analyzing skin disease which is available on Kaggle and GitHub.
2. Fuzzy borders, low brightness and color variations are the issues that vary from image to image. This will always be the greater challenge to segregate the affected area present in dermoscopic images in order to solve this; a deep learning model is required as image super resolution to enhance the quality of image.
3. In most studies, the super-resolution and classification are done separately rather than being trained end-to-end.
4. While high accuracy is often claimed, the study is performed on a small and limited dataset, which may limit the model's generalizability and real-world applicability.
5. There is limited use of image segmentation techniques, which can reduce the model's ability to accurately isolate and analyze lesion regions.
6. The models are primarily assessed on benchmark datasets and not on real images taken by smartphones.
7. Most works treat lesion segmentation and classification separately instead of using integrated frameworks.

5. Objectives of Research

The proposed objectives for research work are given below:

1. To analyze and identify various skin diseases and examine existing classification techniques for their effective identification and differentiation of diseases.
2. To enhance the perceptual quality and structural features of skin images employing image super-resolution techniques in order to improve subsequent analysis.
3. To perform skin lesion segmentation from skin images to precisely localize the affected areas of the skin.
4. To extract discriminative features from segmented skin lesions using appropriate feature extraction techniques to effectively characterize the diseases.
5. To develop a diagnostic model for the detection of skin diseases such as acne, shingles, dermatitis, hives and impetigo and to evaluate its performance against different techniques.

6. Methodology

The proposed methodology introduces a framework for predicting skin diseases. The proposed Architecture is shown in Fig. 10. The dataset consists of a total 1800 images including five skin diseases and normal skin images. To avoid inconsistency in the dataset pre-processing is done and to enhance the quality of the images, image super resolution technique is applied. The images are then segmented, followed by the application of the feature extraction method, and then the classifier is used to detect the disease class.

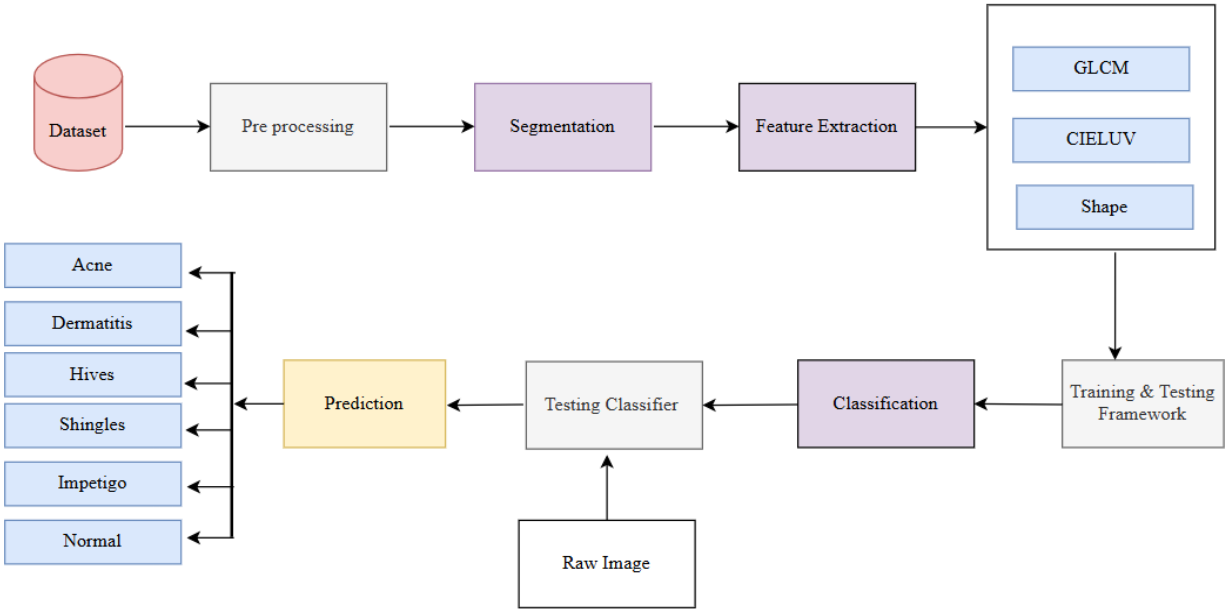


Fig. 10 : Proposed Architecture

Image input- Images are collected and inserted into the system for image processing. The images are collected from various public repositories.

Pre-processing- It is the process in which images are transformed and organized into clear, fixed size and standard format.

Segmentation- It is a process in which an image is partitioned into various segments for easy analysis.

Feature extraction- Once the segmentation is done, features extraction is carried out such as redness level, shape, size etc.

Training and testing- The whole dataset is split into a training set- 70% and testing sets -30%.

Classification- Classification involves organizing images into distinct categories. A classifier that has been properly trained is utilized to categorize images.

Testing classifier- A new raw image will be used as input for the model to evaluate the classifier's performance.

Prediction- The prediction of the class of raw image is done by the model.

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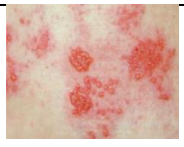
6.1 Skin disease characteristics

According to the statistics of occurrence of skin diseases in India the following diseases have been selected. The proposed model will help to classify the medical images based on their characteristics/symptoms. The following table 3 shows different characteristics of these skin diseases.

Table 3: Comparison of Diseases

	Hives (Urticaria)	Acne	Dermatitis	Shingles	Impetigo
Cause	Allergic reaction, stress, unknown	Hormonal changes, clogged pores, bacteria	Allergens, irritants, genetic factors	Reactivation of chickenpox virus (VZV)	Bacterial infection (Staph or Strep)
Symptoms	Raised, itchy welts	Pimples, blackheads, cysts, oily skin	Itchy, red, dry or flaky skin	Painful rash, blisters in band/strip	Red sores, rupture and form yellow crust
Appearance	Pink or red wheals, skin-colored bumps	Whitehead blackhead, red bumps or cysts	Inflamed patches, possibly cracked	Blistering rash on one side of body	Honey-colored crusts, usually around mouth/nose
Contagious	No	No	No	Yes	Yes
Common Sites	Anywhere on the body	Face, chest, back, shoulders	Hands, face, arms, legs	Torso, one side of face or body	Face, especially around nose and mouth
Duration	Hours to days; chronic form lasts longer	Weeks to years	Acute or chronic (weeks to years)	2–4 weeks	7–10 days (with treatment)
Treatment	Antihistamines, corticosteroids	Topical treatments, antibiotics, retinoids	Moisturizers, steroids, antihistamines	Antiviral drugs, pain relief	Antibiotic creams or oral antibiotics
Age Group	All ages	Teens, young adults	All ages (especially kids for eczema)	Older adults, immune compromised	Mostly children, but adults can be affected
Image					

6.2 Pre processing

It is observed that the medical image-based disease detection system is based on the quality of the images being input into the system. Pre-processing is very important as variations in images caused by lighting conditions; noise etc can affect the performance of the system. Preprocessing steps include resizing of images, augmentation and color conversion etc. Image enhancement techniques are used here to improve important features in images, such as edges, textures, and color patterns. It helps to identify features that are specific to certain diseases and also enhance the perceptual characteristics of images.

Image Super-Resolution

It is a technique that enhances the resolution and quality of images. It is useful in medical imaging as it improves quality of images for better diagnosis as images can be of poor quality due to lighting and camera limitation. Using ISR techniques, texture and edges of skin diseases can be detected more clearly.

Some methods -

- **Convolutional Neural Networks (CNNs):** These architectures learn the direct mapping from LR to HR images.

  Eg. DRCN (Deeply-Recursive Convolutional Network) is an algorithm which uses convolutional layers recursively multiple times to create high resolution images.

- **Generative Adversarial Networks (GANs):** This model uses two neural networks-a generator and a discriminator to produce HR images.

  Eg. ESRGAN (Enhanced Super-Resolution Generative Adversarial Network) ESRGAN is an improved version of SRGAN which includes Residual-in-Residual Dense Blocks (RRDB) for producing better quality images.

- **Attention-Based Transformer Networks:** These models focus on important features of the input and then produce output.

  Eg. HAT (High-Resolution Attention Transformer) is a combination of channel attention and window based self attention for producing high-resolution images.

- **Diffusion Based:** It uses generative ai techniques for generating high-resolution images.

  Eg. StableSR (Stable Super-Resolution) is a diffusion-based model to generate high quality images using latent diffusion and controllable structure-maintaining components.

6.3 Image segmentation

In this method an image is divided into many sections or segments in order to simplify or transform its representation into one that is simpler to understand and analyze [34].

Some Techniques-

Thresholding Techniques

This process of dividing an image into a binary image by separating the pixels in foreground and background. This method is based on the threshold value for separation of pixels.

Types-

Global Thresholding:

In this method single threshold value is used for the whole image. If the pixel value is higher than threshold value it will be foreground and if it is below then it is background.

Eg.

Otsu thresholding method uses histogram and relies on maximizing the variance between different classes or minimizing the variance within classes of pixel values in order to determine the best threshold for distinguishing the foreground from the background in an image.

Adaptive Thresholding: This method calculates different threshold values for different regions in the image.

Watershed Algorithm: This model treats the image as a topographic landscape, where the Pixels which are bright are hills and dark pixels are valleys. Flooding from its minima separates the overlapping objects.

Canny Edge detection: Canny edge detection is used to identify the edges. It evaluates using a Gaussian filter, calculates gradients and discards the weak edges and maintains the strong ones.

GrabCut Segmentation: GrabCut segmentation is a graph based segmentation technique. It uses Gaussian Mixture Models (GMMs) to classify the foreground and background.

6.4 Feature Extraction

Feature extraction is an important process in image processing, where key information is converted into a structured feature vector that can be interpreted by a machine learning or deep learning model. It is the process of extraction of important characteristics like color, shape, texture, edges etc.

Some Feature extraction techniques in image processing-

- **Texture analysis-** Texture feature extraction involves analyzing spatial arrangement of pixel intensities. Eg. Gray Level Co-occurrence Matrix (GLCM), Local Binary Patterns (LBP), and Gabor filters.
- **Shape based-** This feature extraction method captures the geometric characteristics of objects in the image like area, perimeter, eccentricity, compactness etc
- **Color based-** This method provides information of color distribution and intensity variations present in the image. Eg. Color histogram and CIELUV

7. Expected outcome of the research

- The proposed interface offers diagnostic assistance, to reduce the gap in healthcare accessibility gap.
- The interface promotes self assessment as many patients often ignore early skin infection symptoms.
- The interface will collect the new images of skin lesions with proper user consent and contribute to the created improved model.
- The system is designed to provide precise detection of skin diseases.

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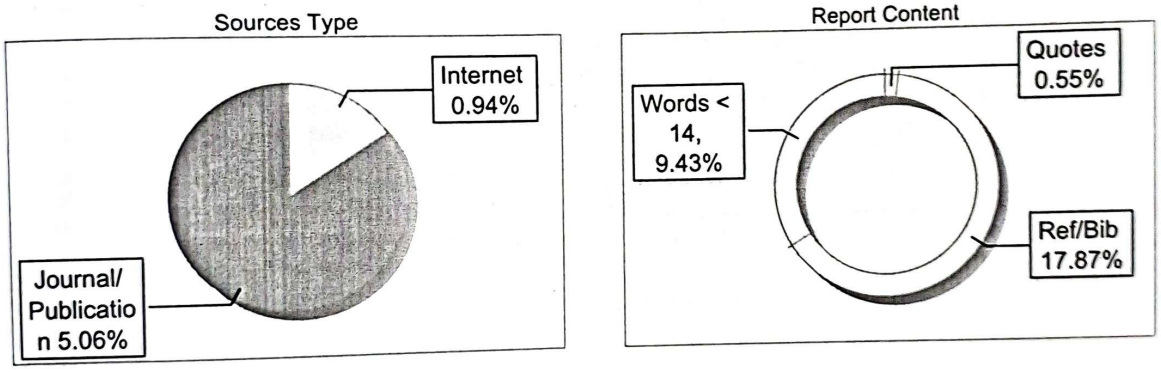

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SKIN DISEASE PREDICTION BASED ON MEDICAL IMAGES USING DEEP LEARNING TECHNIQUES

SHORT SYNOPSIS

by

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ABSTRACT

These days, skin conditions are highly prevalent. If ignored, some of these conditions can lead to skin cancer. Deep learning has emerged as a more effective method for early disease prediction in recent years. Various advancements are made in the healthcare industry to detect various diseases. Deep learning methods are utilized for predicting the diseases and general patient care. These approaches gives improved results and reduce error rates. Using deep learning dermatoscopic images skin diseases can be detected at an early stage.

The proposed study will use image enhancement techniques to improve the quality of images and then apply segmentation techniques to segment the skin lesions. Feature extraction methods are used to extract and important features and then using classification model different skin diseases can be identified. This framework will support clinical decision-making in dermatology.

Keywords: Dermoscopic images, Thresholding, Deep Neural Network, Grabcut segmentation, Feature extraction.

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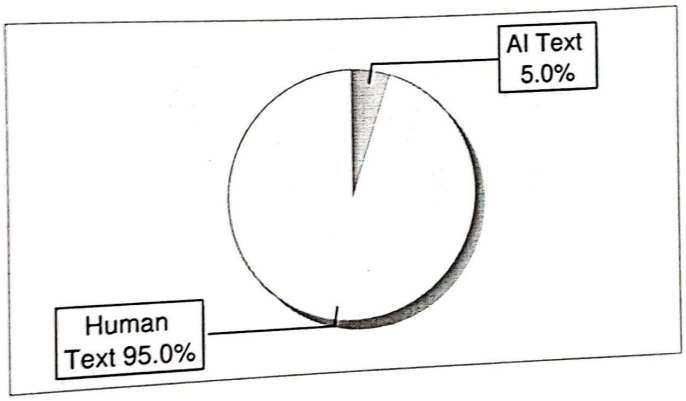

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